

AN ASSEMBLY FOR REMOVING CHIPS FROM A CUTTING WORK AREA OF A CUTTING TOOL

BACKGROUND OF THE INVENTION

5 **1. Field of the invention.**

The present invention relates to an assembly for removing chips and cuttings from a cutting working area of a cutting tool on a workpiece. The assembly of the present invention is adapted to be attached to either an axially movable, non-rotating component of a drilling/milling machine, and to be resiliently biased towards a workpiece in which a hole or a recess is formed;
10 or to be attached to a separate fixed support or stand located close to the workpiece, and to be resiliently biased towards the machine. In particular, but not exclusively, the assembly of the present invention is adapted to be used together with orbital drilling machines.

2. Description of the related art.

When forming holes or recesses in a workpiece by way of a drilling or milling machine,
15 chips and cuttings generated by a cutting tool and remaining in the vicinity of the hole during the forming thereof can adversely effect the surface quality of the hole being formed.

What is needed in the art is a chips-removing assembly, which can efficiently collect and remove chops from a cutting working are while at the same time obtain a full protection of cutting tool in the zone between an advancing nose portion of the machine and the workpeice
20 during a working operation.

SUMMARY OF THE INVENTION

The present invention provides a chips-removing assembly, which can efficiently collect and remove chips from a cutting working area while at the same time obtain a full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece
25 during a working operation.

The invention comprises, in one form thereof, a support structure for supporting a first end of an axially expandable and collapsible tubular member; a cross-piece for supporting a second end of the tubular member; at least one biasing spring configured and arranged for resiliently biasing the support structure and the cross-piece away from one another; a housing with a chips-receiving chamber located adjacent one of the ends of the tubular member for engagement with the working area of the workpiece, an outlet from the chamber of the housing being configured to be connected to a vacuum source for removing chips from the chamber; and a hub portion located at the other of the ends of the tubular member for engagement with a cutting machine. During the working operating the tubular member surrounds the shaft of the cutting tool and defines a space which is substantially closed against a nose portion (e.g. a rotating spindle) of the working machine and which communicates with the chips-receiving chamber so as to improve the evacuation of chips therein and to create a safe protection for the operator in case of a breakdown of the cutting tool.

An advantage of the present invention is that chips and cuttings from a cutting work area are efficiently removed.

Another advantage of the present invention is that it provides a full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece during a working operation.

Yet another advantage of the present invention is an improved surface quality of the hole being formed.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood

by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective view of a first embodiment of the assembly of the present invention;

5 Fig. 2 is perspective view of a second embodiment of the assembly of the present invention, as seen from a frontal side;

Fig. 3 is perspective view of the second embodiment of Fig. 2 as seen from a rear side;

Fig. 4 is an end view of the second embodiment of Fig. 2;

Fig. 5 is a cross-sectional view taken along the line A-A in Fig. 4;

10 Fig. 6 is a perspective view of an orbital drilling machine to which the assembly of Figs. 2-5 is attached.

Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine coordinated with a third embodiment of a cuttings-removing assembly of the present invention;

15 Figs. 8 and 9 are perspective views of the assembly of Fig. 7, seen from the rear side thereof and in an axially collapsed and expanded position, respectively; and

Fig. 10 is a side view of a front portion of an orbital cutting machine and the third embodiment of the assembly in a retracted, unexpanded position in which a tool exchanging operation may take place.

20 Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate one preferred embodiment of the invention, in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and more particularly to Fig. 1, there is shown a first embodiment of assembly 1 of the present invention, which generally includes a support structure 2 carried on a stand 3 that can be positioned close to a workpiece (not shown). Support structure 2 holds a housing 4 with a chips-receiving chamber 5 and one end of an axially expandable and collapsible, tubular member 6 including a helically wound strip of steel or similar strong material so as to form a telescopic spring which is resiliently biased towards its expanded condition shown in Fig. 1. The other end of tubular member 6 carries a hub portion 7 with a pressure plate P configured to engage a front portion, e.g. an end surface of a spindle, of a cutting machine (not shown). Hub portion 7 is attached to a cross-piece 8 which connects hub portion 7 to a linear guide unit 9 at one side of cutting machine for longitudinal guidance of the expansion and collapsing of tubular member 6. A guide block 9a of guide unit 9 is supported on a bracket 10 secured to a stationary machine base B. Guide rods 9b, attached to cross-piece 8, are slideable in guide block 9a. A handle H is attached to cross-piece 8 for manually compressing tubular member 6. Alternately, this is achieved by a pneumatic cylinder (not shown) which facilitates an exchange of a cutting tool in the machine. A vacuum conduit C is connected to chips-receiving chamber 5 for removing chips and cuttings from the working area of the workpiece.

In use, housing 4 is set into engagement with the surface of the workpiece where a hole or recess is to be formed therein. Telescopic tubular member 6 is allowed to axially expand over the cutting tool and its shaft (not shown) so as to bring pressure plate P to resiliently engage the advancing spindle of the cutting machine. During the advancement of the cutting tool into the workpiece, tubular member 6 axially collapses successively against the action of the spring force of resilient member 6. Tubular member 6 forms both a confined space communicating with the chips-receiving chamber 5 so as to improve the evacuation of chips therein, and a strong

protection of the cutting tool in a zone between an advancing nose portion of the machine and the workpiece during a working operation.

Figs. 2 and 3 are perspective views of a second embodiment of assembly 11 of the present invention. Assembly 11 is adapted to be attached to a front portion of an outer housing 12 of an orbital drilling machine 14 (Fig. 6), or any other type of material working machine for drilling or milling holes or recesses in a workpiece, where cuttings and chips are to be removed from the working area.

Assembly 11 includes a U-shaped support structure 16 having two opposed side legs 18 with a rear fastening section 20 for fixating support structure 16 to the axially movable housing 12 of machine 14. Legs 18 are interconnected by a central hub portion 22 which has a cylindrical recess 24 for receiving a front end of an orbiting spindle carrying a rotary cutting tool (not shown) with a small axial play between the bottom of the recess and the end of the spindle. To the outer side of each leg 18 is mounted a respective guide block 26 for linear guidance of two guide rods 28. A cylinder 30 of a pneumatic spring generating a substantially constant spring force is attached to the rear end of each leg 18 and to guide block 26 and has a piston rod 32 extending through block 26. Guide rods 28 and piston rod 32 are fixated to a respective end of a yoke-shaped pressure foot 34, which interconnects the two pairs of guide rods 28 and piston rods 32. Pressure foot 34 carries a central circular housing 36 defining a chamber 38 for receiving cuttings from the hole or recess being formed in a workpiece against which pressure foot 34 is biased by pneumatic springs 30, 32. Chamber 38 communicates with a channel 40, which extends through a branch 42 of pressure foot 34, and is connected to a vacuum source (not shown) via a tubular outlet socket 44.

The one end of an axially expandable and collapsible tubular member 46 is attached to central housing 36, while the other end is attached to central hub portion 22 of support structure

16. Tubular member 46 is configured to accommodate the cutting tool and to define a substantially closed space around it, which could be reduced in volume when the cutting tool advances into the workpiece. Tubular member 46 preferably includes a telescopic spring made of a helically wound strip 48 of a spring material, such as spring steel. Such a tubular member
5 46 may easily be collapsed to an axial dimension substantially equal to the width of strip 48. Alternatively, tubular member 46 may be formed as a resilient bellows. In its most expanded position the axial length of tubular member 46 is such that the tip of the cutting tool mounted to the orbiting spindle will not protrude from the surface of central housing 36 which engages the workpiece.

10 When starting a hole-forming procedure, pressure foot 34 is held at a maximal extended position relative to the drilling machine by way of pneumatic springs 30, 32. Housing 12 of orbital drilling machine 14 is fed axially towards the workpiece by an axial feed motor 50 (Fig. 6) until pressure foot 34 slightly compresses tubular member 46 when it contacts the surface of the workpiece. During further axial advancement of the cutting tool into the workpiece, guide
15 blocks 26 slides forwardly along guide rods 28 against the constant spring force of pneumatic springs 30, 32, while collapsing tubular member 46 axially. Cuttings and chips generated by the cutting tool are removed by the vacuum source via chamber 38, channel 40 and outlet socket 44 during the whole cutting operation so that the hole will not be jammed thereby and the environment will be protected from being polluted.

20 Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine 14 coordinated with a third embodiment of a cuttings-removing assembly 52 of the present invention. Figs. 8 and 9 are perspective views of this assembly, seen from the rear side thereof and in an axially collapsed and expanded position, respectively.

In contrast to the second embodiment, assembly 52 of the third embodiment is configured to be mounted to a support 54, which is fixed relative to workpiece 56 during the working of a hole therein. Assembly 52 includes a central upright member 58 attached to support 54 via an axially adjustable piston rod 60 (Fig. 10). A cylindrical housing 62 defining a chamber for receiving cuttings from the hole or recess being formed is mounted at the top of upright 58 facing workpiece 56. Housing 62 has an outlet opening 64 which is connected to a vacuum source via a hose (not shown) for removing the cuttings from the working area. An upper and a lower lateral bracket 66 and 68 are attached to upright 58 for holding a respective upper and lower, fixed end section 70 of a telescopic pneumatic spring unit 72 and 74. Each spring unit 72, 74 further includes three sections 76, 78, 80 which are axially extendable by separate pneumatic cylinders. The outermost sections 80 of the spring units are carrying between them a cross-piece 82 having a central ring-shaped pressure plate 84 to be engaged by the outer end surface 86 of the orbiting spindle of the drilling machine. As best seen in Figs. 7 and 9, telescoping sections 76, 78, 80 of spring unit 72 form, in its expanded condition, a stair going downwards, while the corresponding sections of spring unit 74 form a stair going upwards.

Cross-piece 82 also holds one end 88 of an axially expandable and collapsible tubular member 90, the other end 92 of which is attached to upright 58 concentrically to housing 62. Like in the first and second embodiments, tubular member 90 is configured to accommodate the cutting tool and to define a substantially closed space around it, which can be reduced in volume when the cutting tool advances into the workpiece. Thus, tubular member 90 preferably includes a telescopic spring made of a helically wound strip 94 of a spring material, such as spring steel. Such a tubular member 90 may easily be collapsed to an axial dimension substantially equal to the width of strip 94.

Pneumatic spring units 72, 74 are adapted to generate a substantially constant spring force that bias tubular member 90 towards the end surface 86 of the tool spindle through pressure plate 84. As shown in Fig. 10, which is a side elevational view showing the mutual positions of assembly 52 and drilling machine 14 during a tool changing phase, telescopic spring sections 76, 78, 80 may be retracted by their respective cylinders to provide a free space between the assembly 52 and the drilling machine for enable easy exchange of the cutting tool.

Pneumatic springs 30 and spring units 72, 74 referred to above can alternatively be formed as hydraulic or electric units for controlling the expansion and retraction of tubular member 46, 90.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.